TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AGENDA ITEM REQUEST

AGENDA REQUESTED: March 7, 2007

DATE OF REQUEST: February 16, 2007

NAME & NUMBER OF PERSON TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED: Dania Grundmann, 239-3449.

CAPTION: Docket No. 2007-0066-TML. Consideration for approval to publish and solicit public comment on one draft TMDL for dissolved oxygen in Mid Cibolo Creek (Segment 1913) of the San Antonio River Basin, in Bexar, Guadalupe, and Comal Counties.
(Faith Hambleton, Marc Friberg)

D.C. Schaubacher

Chief Engineer

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Commissioners Date: February 16, 2007

Thru: LaDonna Castañuela, Chief Clerk

Glenn Shankle, Executive Director

From: David C. Schanbacher, P.E., Chief Engineer DCS
Chief Engineer's Office

Subject: Release of Draft Total Maximum Daily Load for Dissolved Oxygen in Mid Cibolo Creek for Public Comment

Issue Consideration for approval to publish and solicit public comment on one draft TMDL for dissolved oxygen in Mid Cibolo Creek (Segment 1913) of the San Antonio River Basin, in Bexar, Guadalupe, and Comal Counties.

Background and Current Practice One draft TMDL has been prepared as required by Section 303(d) of the Clean Water Act. TMDLs must be submitted to U.S. EPA for approval as certified updates to the State of Texas Water Quality Management Plan (WQMP). Prior to submission of TMDLs to EPA, TCEQ staff request approval from the commission to release the draft TMDLs for a formal public review and comment period. After the public comment period, TCEQ staff make appropriate changes to the draft TMDLs and document public comments for the record. The next step is to request that the commission adopt and certify the final TMDLs as an update to the State of Texas WQMP. The commission approved TMDLs are then forwarded to U.S. EPA for their final approval or disapproval within 60 days.

Question Does the commission approve the Executive Director's request to release for public review and comment the Draft TMDL for dissolved oxygen in Mid Cibolo Creek?

Agency contacts:
Andrew Sullivan, Project Manager, 239-4587, Water Programs Division
Marc Friberg, Staff Attorney, 239-0611

Attachments

cc: Chief Clerk, 5 copies
Executive Director's Office
David C. Schanbacher, P.E.
Jason Skaggs
Ashley K. Wadick
Office of General Counsel

cc (without attachments): Marc Friberg, Staff Attorney
Andrew Sullivan, Project Manager

Mid Cibolo Creek (Segment 1913) TMDL for Dissolved Oxygen
Summary Outline – February 6, 2007

I. Introduction

- The goal of this project is to determine allowable loadings of carbonaceous biological oxygen demand (CBOD) and total ammonia that will enable Mid Cibolo Creek to meet its limited aquatic life use.

II. Background Information

- Mid Cibolo Creek (Figure 1) is a freshwater stream located in the San Antonio River Basin, northeast of San Antonio, Texas, in Guadalupe, Comal and Bexar Counties. It is approximately 19 miles long and has a watershed area of 46 square miles.

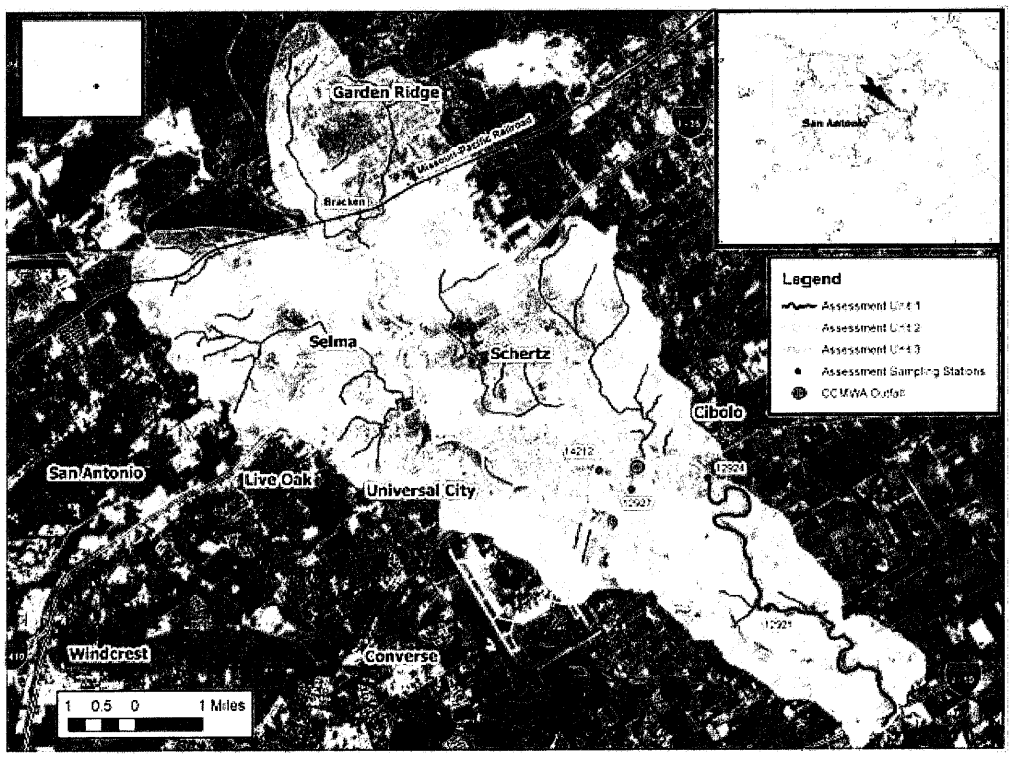

Figure 1. Mid Cibolo Creek Watershed

- The segment extends from a point 100 meters downstream of Interstate Highway 10 in Bexar/Guadalupe County to the Missouri-Pacific Railroad Bridge west of Bracken in Comal County.

- Land use in the area is primarily pasture land and forest; although historically, it was primarily agricultural. However, land use is changing due to residential development associated with the growth of San Antonio.

III. Problem Definition

- This segment was initially included on the 1999 303(d) List as partially supporting the aquatic life use due to depressed dissolved oxygen levels in the stream. A subsequent project, initiated in 2001 to collect additional data, verified the extent and magnitude of the impairment.

- The Cibolo Creek Municipal Water Authority (CCMWA) currently operates the only wastewater treatment plant which discharges to the segment. Based upon self reporting data, concentrations of total ammonia and CBOD exceed limits established in the existing TPDES permit.

- A TMDL project was initiated to quantify appropriate reductions of CBOD and ammonia necessary to comply with established water quality standards.

IV. Endpoint Identification

- The primary endpoint for this TMDL will be based on the daily average effluent limits for CBOD (10 mg/L) and total ammonia (3 mg/L) established in the current TPDES permit for the CCMWA.

V. Source Analysis

- CBOD and total ammonia may come from both point and nonpoint sources.

- The primary source of excess CBOD and ammonia arise from the noncompliance of the CCMWA discharge.

VI. Linkage

- Historical data collected in Mid Cibolo Creek dating back to the 1970s indicate that levels of dissolved oxygen are depressed in response to drought conditions which have occurred periodically.

- To better understand the extent and magnitude of the problem, additional sampling was conducted from 2002-2004 at several stations throughout the watershed. Collection of diurnal dissolved oxygen data indicated levels below the minimum criteria in the mid section of the watershed below the treatment plant.

VII. Allocations

- Load allocations were calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + AFG$$

Where

WLA = wasteload allocation (point source contributions);
LA = load allocation (nonpoint source contributions); and
AFG = allowance for future growth.

- Table 1 below summarizes the load allocations for Mid Cibolo Creek.

Table 1. TMDL Allocation Summary for Mid Cibolo Creek CBOD and ammonia

	CBOD (lbs\day)
Existing Loading	1672.9
Allowable Loading	1482
Waste Load Allocation	517.4
Waste Load Allocation MS4	635.5
Load Allocation	442.4
AFG (7.1%)	113.3
	Total Ammonia (lbs\day)
Existing Loading	603.0
Allowable Loading	168.6
Waste Load Allocation	155.2
Waste Load Allocation MS4	15.5
Load Allocation	10.8
AFG (7.1%)	12.9

VIII. Margin of Safety

- This TMDL uses both an explicit and implicit margin of safety. An explicit margin of safety was derived through estimates of population growth in the San Antonio metropolitan area compiled by the Texas State Data Center. An implicit margin of safety was employed through the application of the QUAL-TX model used to estimate dissolved oxygen levels based on background concentrations and inputs from the CCMWA plant.

IX. TMDL

$$TMDL = \sum WLA + \sum LA + AFG$$

TMDL CBOD = 1153.3 lbs/day + 442.4 lbs/day + (-113.3 lbs/day) = 1482 lbs/day

TMDL Total Ammonia = 170.7 lbs/day + 10.8 lbs/day + (-12.89 lbs/day) = 168.6 lbs/day

In order to meet the TMDL, reductions of **32 and 75 percent** are required for CBOD and total ammonia respectively.

For Public Comment, March 2007

One Total Maximum Daily Load for Dissolved Oxygen in Mid Cibolo Creek

Segment Number 1913

printed on recycled paper

Prepared by the:
Chief Engineer's Office, Water Programs, TMDL Section

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Distributed by the
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, Texas 78711-3087

TMDL Project Reports are also available on the TCEQ web site at:
<www.tceq.state.tx.us/implementation/water/tmdl/>.

The preparation of this report was financed in part through grants from
the U.S. Environmental Protection Agency.

Contents

Figures

Tables

One Total Maximum Daily Load for Dissolved Oxygen in Mid Cibolo Creek

Executive Summary

This document presents the total maximum daily load (TMDL) to address low levels of dissolved oxygen in Mid Cibolo Creek (Segment 1913). Segment 1913 is located northeast of the City of San Antonio in south-central Texas. The segment begins immediately downstream of Interstate 10 and ends at the Missouri-Pacific Railroad Bridge west of Bracken in Comal County. However, only a small reach of Segment 1913, located above Schaefer Road in the city of Cibolo, has been determined to be impaired. The aquatic life use was first identified as impaired in the *State of Texas 1999 Clean Water Act Section 303(d) List* (TCEQ 1999).

The goal for this TMDL is to determine the allowable loading the stream can receive that will still allow support of the aquatic life use. Attainment of the aquatic life use is evaluated by the assessment of dissolved oxygen levels. Although not considered a pollutant, dissolved oxygen is an indicator of excessive loadings of certain pollutants. Levels of dissolved oxygen are occasionally depressed in Mid Cibolo Creek, likely due to the presence of excess nutrients or other oxygen demanding substances originating from sources within the watershed.

In 2001, the Texas Commission on Environmental Quality (TCEQ) initiated an investigation to verify the extent of the use impairment. Field investigations revealed that levels of dissolved oxygen fall below the minimum criteria during low flow periods (critical conditions). Additional analysis identified a single point source that is currently out of compliance with existing permit limits which is most likely responsible for the observed problems.

Based on the load allocation analysis, a TMDL allocation plan to meet the standards for limited aquatic life use requires:

- 32 percent reduction of loading of CBOD
- 75 percent reduction of loading of ammonia-nitrogen

Introduction

Section 303(d) of the Clean Water Act requires all states to identify waters that do not meet, or are not expected to meet, applicable water quality standards. For each listed water body that does not meet a standard, states must develop a total maximum daily load (TMDL) for each pollutant that contributes to the impairment of water. The TCEQ is responsible for ensuring that TMDLs are developed for impaired surface waters in Texas.

In simple terms, a TMDL is similar to a budget that determines the amount of a particular pollutant that a water body can receive and still meet its applicable water quality standards. TMDLs are the best possible estimates of the assimilative capacity of the water body for a pollutant under consideration. A TMDL is commonly expressed as a load with units of mass per period of time, but may be expressed in other ways. TMDLs must also estimate how much the pollutant load must be reduced from current levels in order to achieve water quality standards.

This TMDL will address impairments to the limited aquatic life use due to low dissolved oxygen in Mid Cibolo Creek (Segment 1913). The TMDL Program is a major component of Texas' overall process for managing surface water quality. The TMDL Program addresses impaired or threatened streams, reservoirs, lakes, bays, and estuaries (water bodies) in, or bordering on, the state of Texas. The primary objective of the TMDL Program is to restore and maintain the beneficial uses (such as drinking water supply, recreation, support of aquatic life, or fishing) of impaired or threatened water bodies.

Section 303(d) of the Clean Water Act and the implementing regulations of the U.S. Environmental Protection Agency (EPA) (40 Code of Federal Regulations, Part 130) describe the statutory and regulatory requirements for acceptable TMDLs. The EPA provides further direction for developing TMDLs in its *Guidance for Water Quality-Based Decisions: The TMDL Process* (USEPA 1991). This TMDL document has been prepared in accordance with those regulations and guidelines. The TCEQ must consider certain elements in developing a TMDL; they are described in the following sections:

- Problem Definition
- Endpoint Identification
- Source Analysis
- Linkage Analysis
- Seasonal Variation
- Margin of Safety
- Pollutant Load Allocation
- Public Participation
- Implementation and Reasonable Assurance

The commission adopted this document on Month, Day, Year. Upon EPA approval, this TMDL will become an update to the state's Water Quality Management Plan.

Problem Definition

Mid Cibolo Creek is a third order, freshwater stream situated in the San Antonio River Basin. It originates west of Boerne and flows to the San Antonio River southeast of San Antonio. Mid Cibolo Creek is 19 miles long with a 46-square-mile watershed in the San Antonio River Basin. It extends from a point 100 meters downstream of Interstate Highway 10 in Bexar/Guadalupe County to the Missouri-Pacific Railroad Bridge west of Bracken in Comal County (Figure 1).

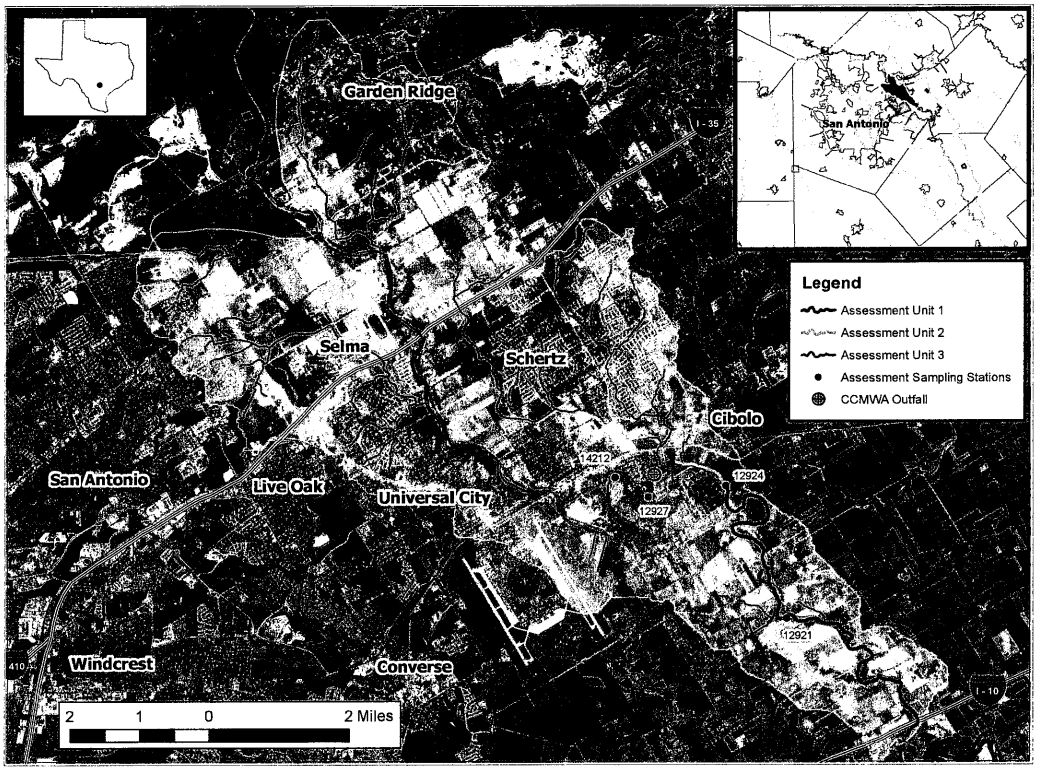

Figure 1. Project Watershed

Land use in the area is primarily pasture and forest, although historically, it was primarily agricultural. However, land use is changing due to residential development associated with the growth of San Antonio (Figure 2). The upper portion of Mid Cibolo Creek is included in the Edwards Aquifer recharge zone; as a result, it typically does not flow under normal conditions.

Mid Cibolo Creek is designated for contact recreation, limited aquatic life use, and public water supply in Appendix A of the *Texas Surface Water Quality Standards* (TCEQ 2000). The criteria for assessing the limited aquatic life use are based on the evaluation of dissolved oxygen concentrations, rather than direct measurements of oxygen-demanding substances such as carbonaceous biochemical oxygen demand (CBOD) and ammonia-nitrogen (NH_3-N).

The limited aquatic life use designation for Mid Cibolo Creek was based on the presence of tolerant (non-sensitive) biological communities that are adapted to low flows associated with the extreme weather conditions in this portion of Texas. Dissolved oxygen criteria for the limited aquatic life use are presented in Table 1.

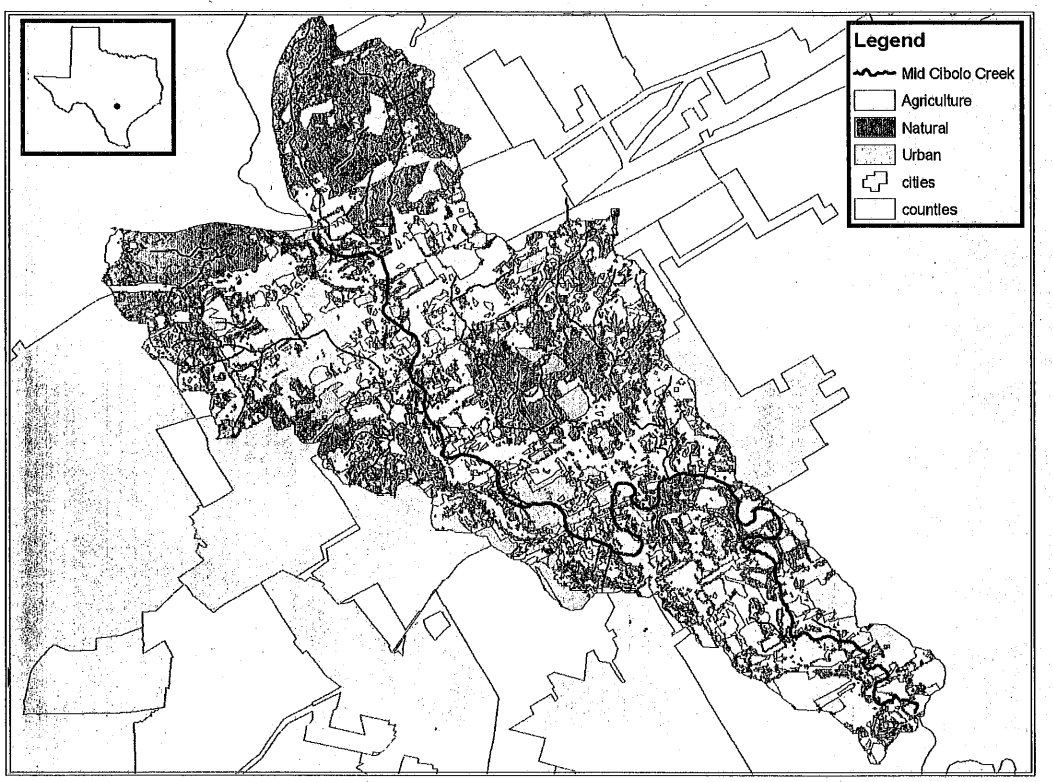

Figure 2. Land Use

Table 1: Criteria for Attainment of the Limited Aquatic Life Use

Use	Dissolved Oxygen Criteria	
	Daily Minimum (mg/L)	24-hour Average (mg/L)
Limited Aquatic Life	2.0	3.0

This segment was initially included on the 1999 303(d) List as partially supporting the aquatic life use due to depressed dissolved oxygen levels in the stream. The results for the most recent *Texas Water Quality Inventory and 303(d) List* (TCEQ 2004) are included in Table 2. The table identifies assessment units that represent hydrologically similar portions of the segment, which are delineated in Figure 1.

The conclusion that Mid Cibolo Creek was impaired in 1999 was based on the comparison of individual grab samples to the 24-hour average dissolved oxygen criterion. Historically, dissolved oxygen levels in Mid Cibolo Creek have been highly variable due to the extreme weather conditions experienced in this region of Texas. Figure 3 illustrates dissolved oxygen grab samples collected throughout the entire Mid Cibolo segment from 1968 through 2001. Drought conditions and corresponding low flow conditions in the mid 1980s and 1990s contributed to low levels of dissolved oxygen in the stream.

In recent years, new methods of measuring instream water quality have produced data that allows for more in depth assessment, particularly with respect to aquatic life use evaluations. Deployable data loggers offer the capability for continuous water quality measurements over a specified period of time. This provides for the calculation of average and minimum values for several water quality parameters, including dissolved oxygen. The 2002 *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data* (TCEQ 2002) requires this type of information when making decisions about aquatic life use attainment. The TCEQ used deployable data loggers to collect conventional and chemical water quality data to assess the limited aquatic life use in Mid Cibolo Creek. Biological data were also collected. The dissolved oxygen data for each of the assessment units is presented in Figures 4a, 4b, and 4c.

The data used to determine that Mid Cibolo Creek is impaired was retrieved from the TCEQ's ambient monitoring database (TRACS). This data demonstrated that 24-hour dissolved oxygen levels in Assessment Units 1 and 3 resulted no excursions of either the minimum or average criteria (Figures 4a and 4c). This data demonstrated that minimum levels of dissolved oxygen did not meet the criterion (2.0 milligrams per liter (mg/L)) in several instances in Assessment Unit 2 (Figure 4b). Based on this data, the TCEQ initiated a TMDL to identify the sources causing the problem and determine measures to remediate the impairment.

Table 2: 2004 Water Quality Assessment

Assessment Unit	Description	Assessment Method	Number of Samples	Exceedances
1913_01	Lower 7 miles of segment from IH 10 to Bexar CR 320	Dissolved oxygen grab average	32	0
1913_02	From Schaefer Road (Bexar CR 320) to approx. 0.10 miles upstream of Buffalo Ln in Cibolo	Dissolved oxygen grab average	10	0
1913_03	From approx. 0.10 mi. upstream of Buffalo Ln in Cibolo to upper end of segment	Dissolved oxygen grab average	22	4
1913_01	Lower 7 miles of segment from IH 10 to Bexar CR 320	Dissolved oxygen grab minimum	32	0
1913_02	From Schaefer Road (Bexar CR 320) to approx. 0.10 miles upstream of Buffalo Ln in Cibolo	Dissolved oxygen grab minimum	10	0
1913_03	From approx. 0.10 mi. upstream of Buffalo Ln in Cibolo to upper end of segment	Dissolved oxygen grab minimum	22	2

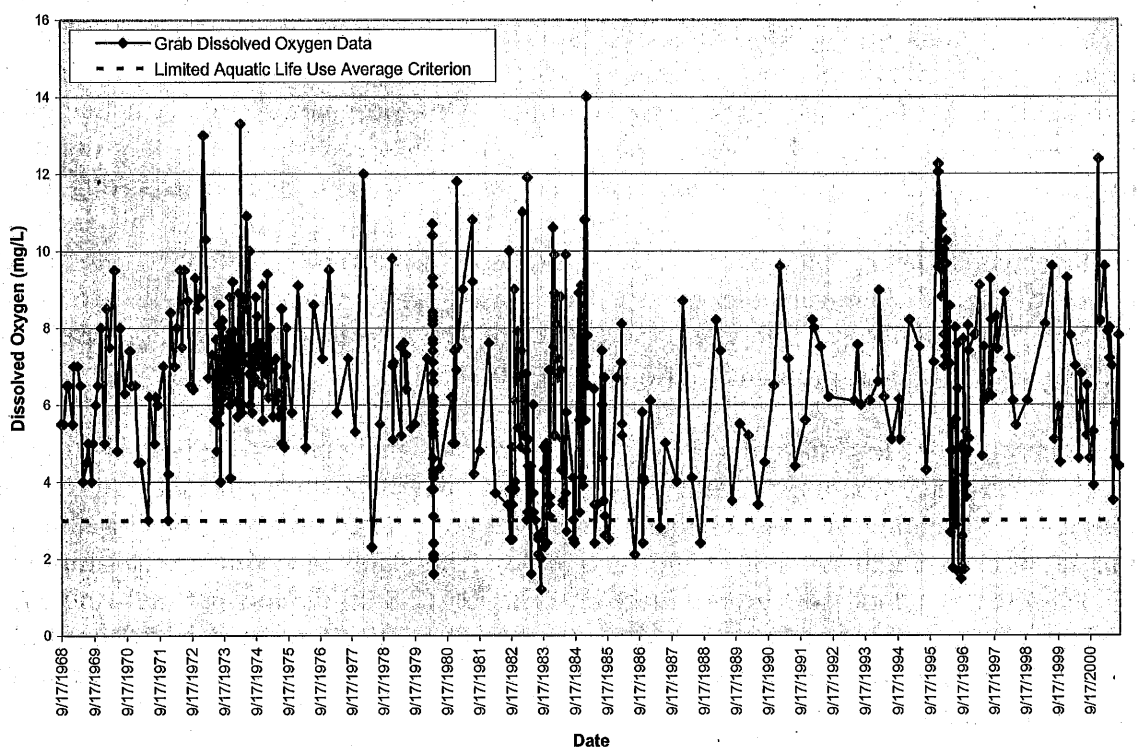

Figure 3. Historical Dissolved Oxygen Data

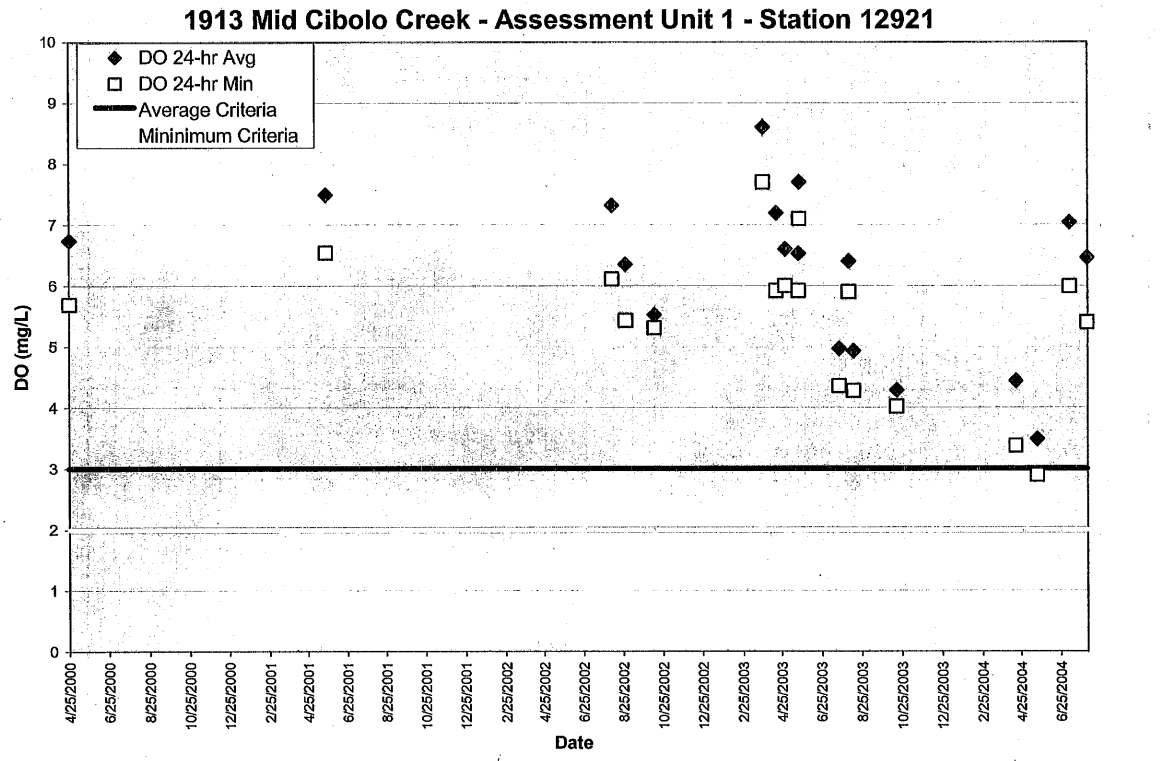

Figure 4a. Assessment Unit 1 Dissolved Oxygen Data

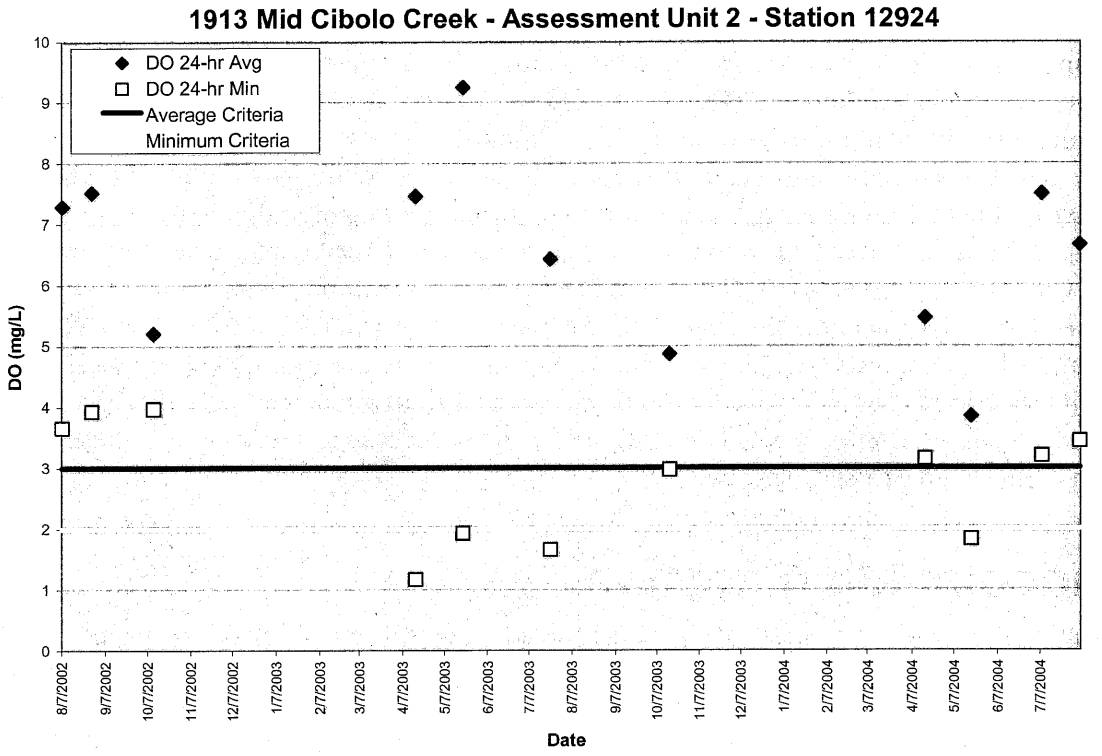

Figure 4b. Assessment Unit 2 Dissolved Oxygen Data

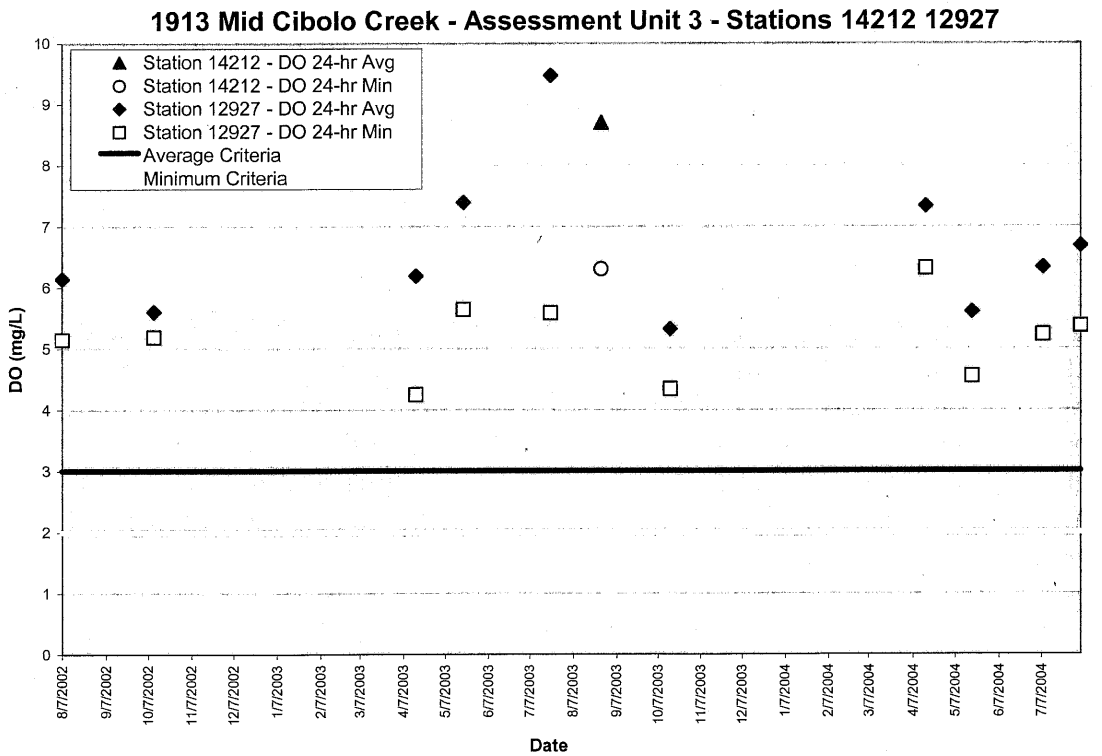

Figure 4c. Assessment Unit 3 Dissolved Oxygen Data

The observed depressed dissolved oxygen concentrations coincide with increased loadings from point sources in the Mid Cibolo Creek watershed. The Cibolo Creek Municipal Water Authority's (CCMWA) Odo J. Riedel Wastewater Treatment Plant is the single point source discharge in the Mid Cibolo Creek watershed. In recent years, this plant has experienced significant increases in pollutant loadings (Figures 5a and 5b), primarily due to water conservation efforts within the service area that resulted in a more elevated influent CBOD concentrations. Concerns about increasing pollution levels in Mid Cibolo Creek have been documented in the report, *Troubled Waters: An Analysis of Clean Water Act Compliance, July 2003-December 2004* (ETRPC 2006). The CCMWA is currently under enforcement by the TCEQ and is in the process of upgrading the facility to comply with Texas Pollutant Discharge Elimination System (TPDES) permit limits. Levels of ammonia-nitrogen and CBOD are expected to comply with these limits upon completion of these upgrades.

Endpoint Identification

Aquatic life use criteria must be maintained through the control of point source discharges under the TPDES. Attainment of dissolved oxygen criteria is ensured through water-quality-based limits included in state-issued permits. Specifically, permits issued by the TCEQ include limits for CBOD and ammonia-nitrogen, which can affect the levels of dissolved oxygen in receiving waters. The TCEQ derives these limits using the QUAL-TX model, based on steady-state conditions and segment-specific waste load evaluations (WLEs).

Mid Cibolo Creek is included in the *Waste Load Evaluation for Cibolo Creek Below the Edwards Aquifer Recharge Zone in the San Antonio River Basin* (TWC 1987). This document includes estimates of loading to Cibolo Creek from all point sources within the segments below the Edwards Aquifer Recharge Zone. As mentioned previously, the CCMWA represents the sole point source to Mid Cibolo Creek. The existing TPDES permit includes limits for CBOD and ammonia nitrogen (NH_3-N) are 10 mg/L and 3.0 mg/L, respectively, based on the QUAL-TX model and the WLE.

Analysis for this TMDL indicates that the resulting instream levels of CBOD and NH_3-N will be 7.31 mg/L and 2.24 mg/L, respectively, at the point where the discharge enters the stream. The analysis assumes that the facility is discharging the maximum permitted flow (6.2 million gallons per day (MGD)) and that the 7Q2 flow upstream of the discharge point is 2.5 cubic feet per second (cfs). These levels are predicted to result in a minimum daily average dissolved oxygen concentration of 2.9 mg/L approximately 2 miles downstream of the discharge.

The endpoints for these TMDLs are concentrations of 10 mg/L of CBOD and 3 mg/L of NH_3-N, which should result in attainment of the 24-hour average and minimum dissolved oxygen criteria to support aquatic life use.

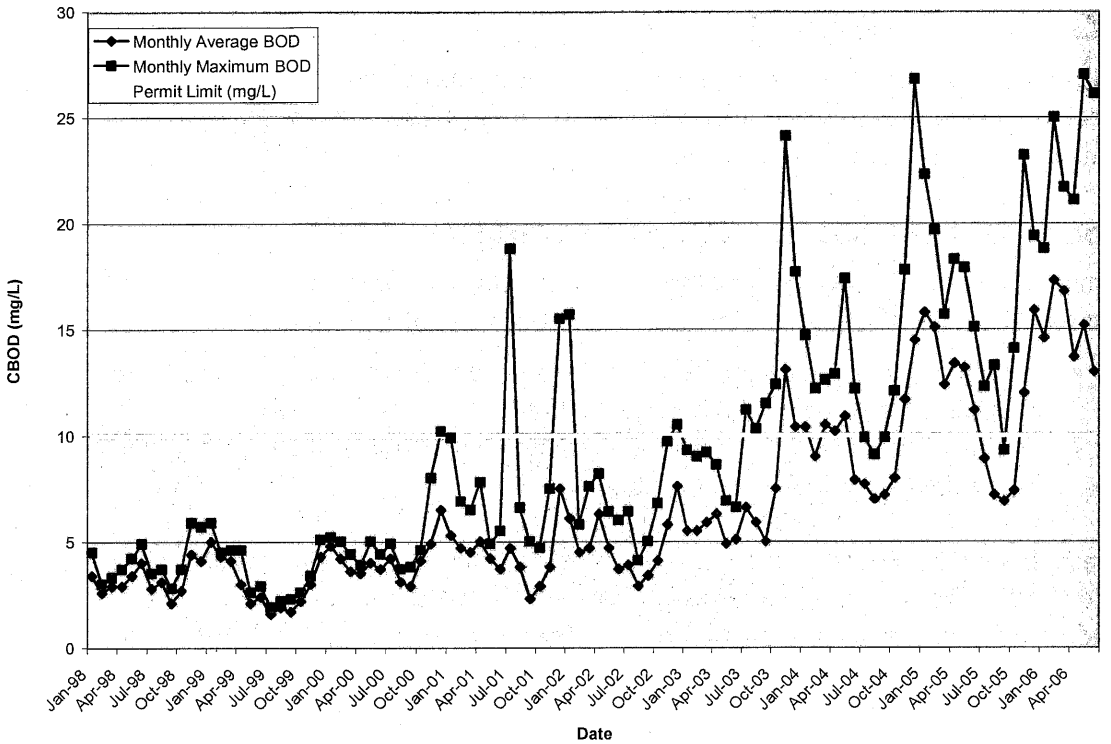

Figure 5a. Monthly CBOD in Cibolo Creek Municipal Water Authority Discharge

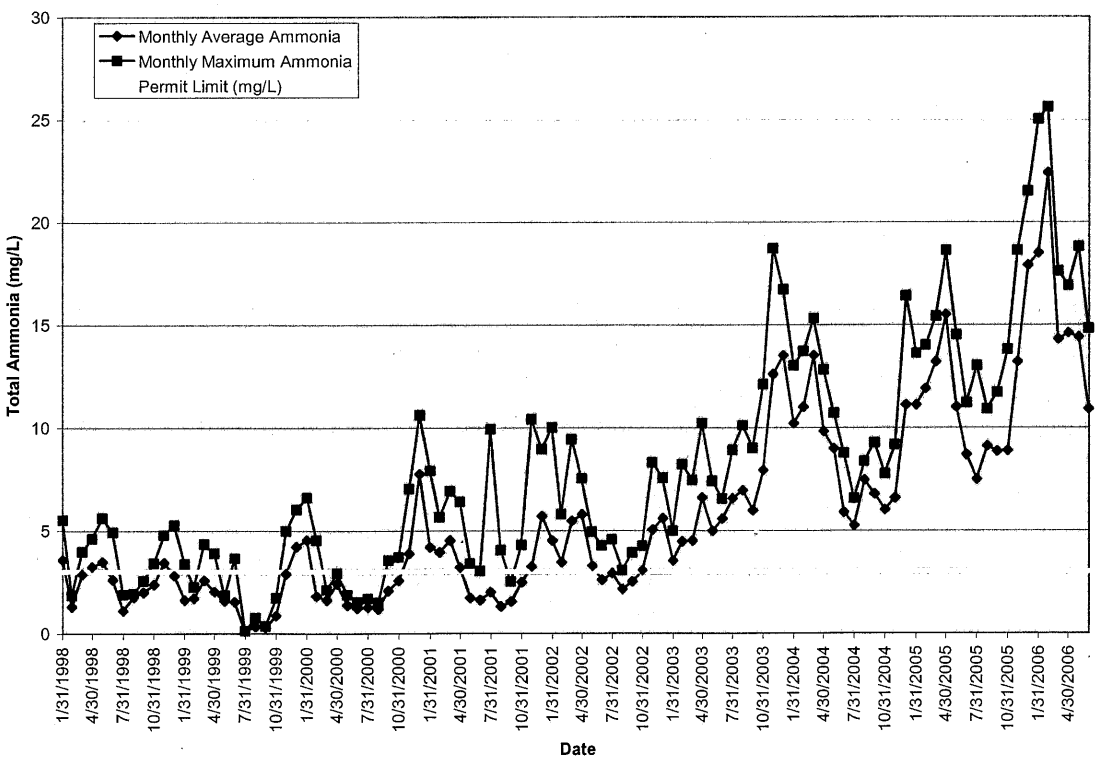

Figure 5b. Monthly Ammonia-Nitrogen in Cibolo Creek Municipal Water Authority Discharge

Source Analysis

Pollutants may come from several sources, both point and nonpoint. The Mid Cibolo Creek watershed includes both types of sources. Nonpoint sources of pollutants are limited to runoff from land surfaces.

Nonpoint Sources (Load Allocations)

Nonpoint sources of pollution include all diffuse sources resulting from land surface runoff. Nonpoint sources of oxygen demanding substances to Mid Cibolo Creek include:

- Loads in the creek originating from the watershed of Upper Cibolo Creek, Segment 1908 (outside the project watershed)
- Loads in runoff that flow directly to Mid Cibolo Creek within its delineated watershed (inside the project watershed)

Load allocations were developed using both estimates from the watershed upstream of Mid Cibolo Creek as well as from within the watershed itself. Low-flow nonpoint source loadings are based on the headwater conditions specified in the QUAL-TX model, as documented in the Cibolo Creek WLE. Specifically, low-flow load allocations for CBOD ($LFLA_{CBOD}$) and ammonia-nitrogen ($LFLA_{NH}$) are calculated as follows:

(a) $LFLA_{CBOD}$ = (CBOD concentration)(headwater flow)(conversion factor)
$LFLA_{CBOD}$ = (1.3mg/L)(1.62 MGD)(8.345)
$LFLA_{CBOD}$ = (17.57 lbs/day)

(b) $LFLA_{NH}$ = (NH_3N concentration)(headwater flow)(conversion factor)
$LFLA_{NH}$ = (0.05mg/L)(1.62 MGD)(8.345)
$LFLA_{NH}$ = (0.676 lbs/day)

Concentrations of ammonia-nitrogen and CBOD are from the WLE for Cibolo Creek (TWC 1987). The conversion factor translates the units of measure for flow and concentration to pounds per day (lbs/day).

Additionally, nonpoint source loadings resulting from rainfall runoff were developed for both inside and outside the project watershed. Flow data from the USGS gage located on Cibolo Creek at Selma, Texas (gage number 08185000), was used to develop these portions of the load allocation. The load allocations for runoff from outside the watershed (HFLA) were calculated using the annual average flow at the Selma gage (14.15 MGD) and the event mean concentration (EMC) for each constituent (City of Austin 2005):

(c) $HFLA_{CBOD}$ = (CBOD EMC)(annual average flow)(conversion factor)
$HFLA_{CBOD}$ = (7.47 mg/L)(14.15 MGD)(8.345)
$HFLA_{CBOD}$ = (882.4 lbs/day)

(d) $HFLA_{NH}$ = (NH_3N EMC)(annual average flow)(conversion factor)
$HFLA_{NH}$ = (0.180 mg/L)(14.15 MGD)(8.345)
$HFLA_{NH}$ = (21.3 lbs/day)

The load allocations originating from storm events within the watershed (INTLA) were also estimated. The flows used in this formula were derived as the ratio of the annual average flow (17 MGD) to the size of the watershed above the Selma gage (274 square miles) multiplied by the size of the Mid Cibolo watershed (46 square miles) The allocations were calculated using the following formula:

(e) $INTLA_{CBOD}$ = (CBOD EMC)(annual average flow)(conversion factor)
$INTLA_{CBOD}$ = (7.47 mg/L)(2.85 MGD)(8.345)
$INTLA_{CBOD}$ = (177.97 lbs/day)

(f) $INTLA_{NH}$ = (NH_3N EMC)(annual average flow)(conversion factor)
$INTLA_{NH}$ = (0.180 mg/L)(2.85 MGD)(8.345)
$INTLA_{NH}$ = (4.29 lbs/day)

The sum of the different nonpoint sources represents the total load allocations for CBOD and ammonia-nitrogen:

(g) $LA_{CBOD} = LFLA_{CBOD} + HWLA_{CBOD} + INTLA_{CBOD}$
LA_{CBOD} = (1077.9 lbs/day)

(h) $LA_{NH} = LFLA_{NH} + HWLA_{NH} + INTLA_{NH}$
LA_{NH} = (26.27 lbs/day)

Point Sources (Waste Load Allocations)

Mid Cibolo Creek receives point source discharge from only the CCMWA plant. CBOD and ammonia-nitrogen loads were calculated using the daily-average flow limits established in the individual permits.

Loading estimates for the CCMWA plant were developed using the average pollutant concentrations since January 1, 2004, included in self-reporting data and the maximum permitted flow. Waste load allocation loadings from point sources for CBOD (WLA_{CBOD}) and ammonia-nitrogen (WLA_{NH}) were developed using the following formulas:

(i) WLA_{CBOD} = (average CBOD concentration)(permitted flow)(conversion factor)
WLA_{CBOD} = (11.5 mg/L)(6.2 MGD)(8.345)
WLA_{CBOD} = 595 lbs/day

(j) WLA_{NH} = (average NH_3N concentration)(permitted flow)(conversion factor)
WLA_{NH} = (11.15 mg/L)(6.2 MGD)(8.345)
WLA_{NH} = 576.8 lbs/day

Non-Continuous WLA

Loads associated with storm water discharges in urbanized areas covered under a Municipal Separate Storm Sewer System (MS4) General Permit should be accounted for in the WLA. The determination of the portion of the load attributed to storm water under the MS4 permit was based on the portion of the Mid Cibolo Creek watershed that is

considered urbanized according to the 1990 U.S. Census (59%). This portion can then be removed from the load allocation and included in the waste load allocation.

(k) $WLA_{CBODMS4}$ = LA * % Watershed Urbanized, where
$WLA_{CBODMS4}$ = 1077.9 lbs/day * 0.59
$WLA_{CBODMS4}$ = 635.9 lbs/day

(l) WLA_{NHMS4} = LA * % Watershed Urbanized, where
WLA_{NHMS4} = 26.3 lbs/day * 0.59
WLA_{NHMS4} = 15.5 lbs/day

Total Loads

The estimated existing total loads of CBOD and ammonia-nitrogen to Mid Cibolo Creek are presented in Table 3. The majority of the loading responsible for the impairment is likely attributed to the municipal point source discharge expressed in the waste load allocation (WLA).

Linkage Analysis

Observed minimum levels of dissolved oxygen in Mid Cibolo Creek currently exceed the water quality criterion to protect a limited aquatic life use. This condition corresponds to increased loadings of oxygen-demanding substances from the CCMWA discharge to Mid Cibolo Creek. This situation is expected to persist until upgrades to the CMMWA plant have been completed and the stream is allowed to return to equilibrium. After the upgrades have been completed, dissolved oxygen concentrations should return to levels above the minimum criterion specified in the water quality standards.

Table 3: Summary of Current Loadings to Mid Cibolo Creek

Source	Constituent (lbs/day)	
	CBOD	NH_3-N
LA	1077.9	26.3
WLA	595	576.8
Total	1672.9	603.1

Seasonal Variation

Seasonal trends in dissolved oxygen are evident from the water quality data collected in Mid Cibolo Creek. These trends can be attributed more to differences in seasonal temperatures and instream flows rather than to varying concentrations of CBOD and ammonia-nitrogen.

The CCMWA discharge, however, exhibits variability in flow, and thus effluent loads, related to seasonal factors. During the summer months, increased water re-use reduces the discharge (and load). This has resulted in decreased loadings of CBOD and ammonia-nitrogen during summer periods relative to other times of the year.

Margin of Safety

The margin of safety (MOS) is a required component of the TMDL to account for any lack of knowledge concerning the relationship between effluent limitations and water quality. According to EPA guidance (Guidance for Water Quality-Based Decisions: The TMDL Process, 1991), the MOS can be incorporated into the TMDL using two methods:

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations; or
- Explicitly specifying a portion of the TMDL as the MOS (allowance for future growth (AFG)) and using the remainder for allocations.

The MOS for this TMDL is incorporated both implicitly and explicitly. The QUAL-TX model applies conservative assumptions when deriving the target instream concentrations. This provides additional insurance that permits issued by the TCEQ will comply with applicable water quality standards. The inclusion of an allowance for future growth (AFG) is considered to be an explicit margin of safety in the overall TMDL equation.

In 2004, the Texas State Data Center predicted a population growth of 7.1 percent between 2005 and 2015 for the San Antonio Metropolitan Area; this figure was used as the AFG.

Pollutant Load Allocation

Typically, there are several potential allocation strategies that would achieve the TMDL endpoint and water quality standards. Available control options depend on the number, location, and character of pollutant sources. In this situation, the observed impairment is due to the noncompliance of a single point source discharge. Compliance with current permit limits should allow the stream to attain water quality standards. For this reason, the entire load reduction, representing permit excursions, will be taken from the WLA (WLA = Existing Point Source Loading – Load Reduction – AFG).

Tables 4 and 5 compare the load, concentration, and flow calculated for the current and target scenarios for CBOD and ammonia-nitrogen using the existing permitted flows (included in the WLA), and present the load reductions required to support the target values to meet the aquatic life use. Based on this assessment, reductions of 203.5 lbs/day and 434.78 lbs/day for BOD and ammonia-nitrogen, respectively, are necessary to comply with existing TPDES permit limits.

Table 4. Comparison of Load (L), Concentration (C), and Flow (Q) for the Current, Target, and Load Reductions Necessary to Achieve the Targeted CBOD Concentration

Scenarios	CBOD Load (lbs/day)[1]	Concentration (mg/L)	Flow (MGD)
Current	595	11.50	6.2
Target	517.4	10	6.2
AFG (7.1%)	113.3	---	---
Load Reduction	190.88	---	---

[1]L (lbs/day) = C (mg/L) * Q (MGD) * (Conversion Factor)
= C (mg/L) * Q (MGD) * (8.345)
= C * Q * 8.345

Table 5. Comparison of Loads (L), Concentrations (C), and Flows (Q) for the Current, Target, and Load Reductions Necessary to Achieve the Targeted Ammonia-Nitrogen Concentration

Scenarios	NH_3-N Load (lbs/day)[1]	Concentration (mg/L)	Flow (MGD)
Current	576.78	11.15	6.2
Target	155.21	3	6.2
AFG (7.1%)	12.89	---	---
Load Reduction	434.45	---	---

[1]L (lbs/day) = C (mg/L) * Q (MGD) * (Conversion Factor)
= C (mg/L) * Q (MGD) * (8.345)
= C * Q * 8.345

The TMDL represents the maximum amount of pollutant that the stream can receive without exceeding the water quality standard. The load allocations for the selected scenarios are calculated using the following equation:

(m) TMDL = LA + WLA - AFG Where:
LA = load allocation (nonpoint source contributions);
WLA = wasteload allocation (point source allocation); and
AFG = allowance for future growth.

Values derived in the source analysis were used in this equation to develop the TMDL for Mid Cibolo Creek for CBOD and ammonia-nitrogen.

(n) $TMDL_{CBOD} = \sum LA + \sum WLA - AFG$, where
$TMDL_{CBOD} = (LA_{CBOD} - WLAC_{CBODMS4}) + (WLA + WLA_{CBODHMS4}) - AFG$
$TMDL_{CBOD} = (1077.9$ lbs/day - 635.9 lbs/day) + (517.39 lbs/day + 635.9 lbs/day) – 113.3 lbs/day

$TMDL_{CBOD}$ = 442.4 lbs/day + 1153.3 lbs/day – 113.3 lbs/day
$TMDL_{CBOD}$ = 1482 lbs/day

(o) $TMDL_{NH3\text{-}N} = \sum LA + \sum WLA + AFG$, where
$TMDL_{NH3\text{-}N} = (LA_{NH3\text{-}N} - WLA_{NHMS4}) + (WLA + WLA_{NHMS4}) - AFG$
$TMDL_{NH3\text{-}N}$ = (26.3 lbs/day - 15.5 lbs/day) + (155.2 lbs/day + 15.5 lbs/day) – 12.89 lbs/day
$TMDL_{NH3\text{-}N}$ = 10.8 lbs/day + 170.7 lbs/day – 12.89 lbs/day
$TMDL_{NH3\text{-}N}$ = 168.6 lbs/day

The effects of reducing the current CBOD and NH_3-N loads should have a significant positive impact on downstream dissolved oxygen concentrations. The effect of these reductions on downstream dissolved oxygen concentrations is demonstrated in Figure 6, which depicts the results produced by the QUAL-TX model when using permitted and actual conditions. Average dissolved oxygen concentrations should reach a minimum value of 2.9 mg/L approximately 1.2 miles downstream from the point of the CCMWA discharge. These reductions should also have a similar effect on the 24-hour dissolved oxygen concentrations.

As shown in Figure 6, the model indicates that under current conditions the average dissolved oxygen values (blue line) in the stream will not meet the criterion for average dissolved oxygen to support a limited aquatic life use (3.0 mg/L). However, measurements taken during the 2002-2004 period indicate that average dissolved oxygen values met the criteria (Figure 4b). This discrepancy between simulated and measured dissolved oxygen values can be explained by the fact that QUAL-TX is a steady-state model and does not account for the effects on dissolved oxygen dynamics from eutrophication caused by excess nutrients. In these cases, large variations, as observed in the data, occur between average and minimum dissolved oxygen values.

Public Participation

The public and stakeholder participation process in TMDL development, "Public Participation in TMDL Projects: A Guide for Lead Organizations" is available on the web at <www.tceq.state.tx.us/implementation/water/tmdl/tmdlresources.html>.

A public meeting for this project was held on July 27, 2006, in Cibolo, Texas. This meeting provided background information on the water quality impairment and the objectives and status of the current study. The meeting was attended by local residents and representatives from government and utilities, including representatives of the discharger affected by this TMDL.

More information about public participation in TMDL development and implementation can be found on the web at: <www.tceq.state.tx.us/implementation/water/tmdl/tmdlresources.html>.

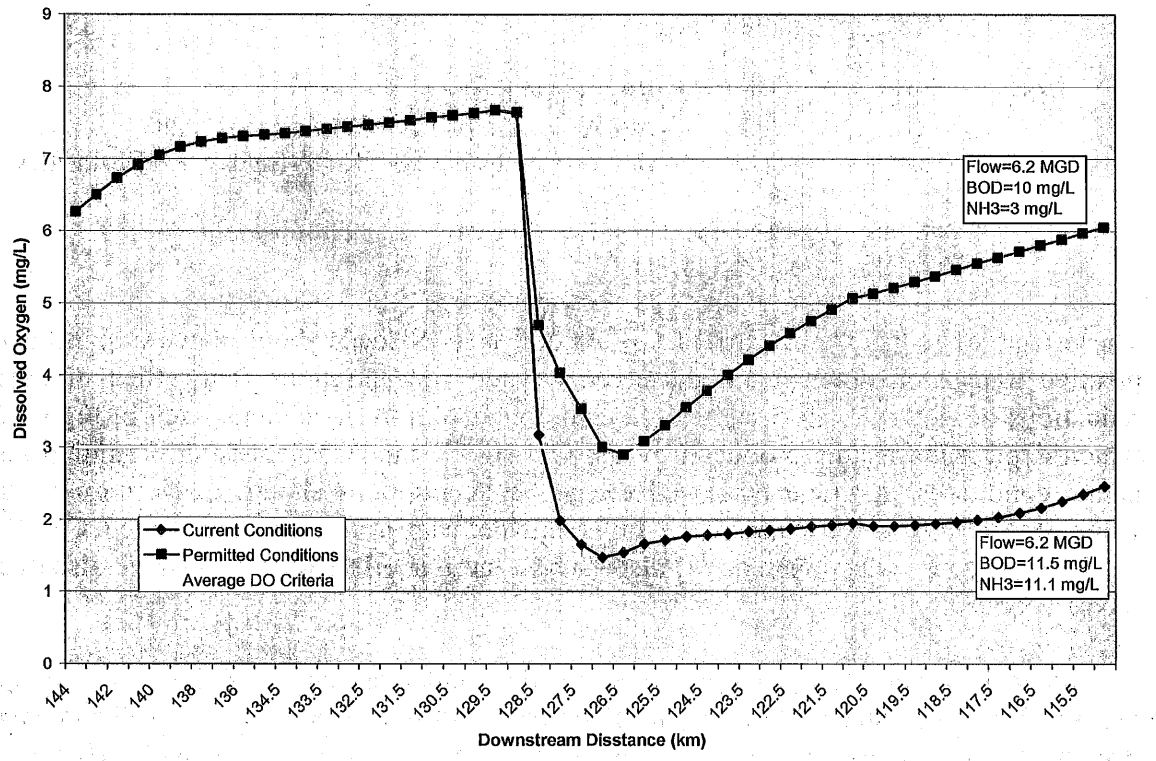

Figure 6. Predicted Downstream Dissolved Oxygen Concentrations Based upon QUAL-TX Calculations

Implementation and Reasonable Assurances

The TMDL development process involves the preparation of two documents:

1) a TMDL, which determines the maximum amount of pollutant a water body can receive in a single day and still meet applicable water quality standards, and
2) an implementation plan (I-Plan), which is a detailed description and schedule of the regulatory and voluntary management measures necessary to achieve the pollutant reductions identified in the TMDL.

During TMDL development, the TCEQ determines the acceptable pollutant load for impaired water bodies and apportions the load among broad categories of pollutant sources in the watershed. This information is summarized in a TMDL report such as this document.

During TMDL implementation, the TCEQ develops the management strategies needed to restore water quality to an impaired water body. This information is summarized in an implementation plan (I-Plan) which references, but is separate from, the TMDL document. The I-Plan details load reduction and other mitigation measures planned to restore water quality in an impaired water body.

The TCEQ is committed to developing I-Plans for all TMDLs adopted by the commission and to ensuring the plans are implemented. I-Plans are critical to ensure water quality standards are restored and maintained. They are not subject to EPA approval.

I-Plans to achieve the recommended loadings may use an adaptive management approach that achieves initial loading allocations from a subset of the source categories. An adaptive management approach allows for development or refinement of technologies that achieve the environmental goal of the plan.

Periodic and repeated evaluations of the effectiveness of implementation measures assure that progress is occurring, and may show that the original distribution of loading among sources should be modified to increase efficiency while maintaining the objective of compliance with water quality standards.

This approach provides reasonable assurances that the necessary regulatory and voluntary activities to achieve the pollutant reductions identified will be implemented. In addition, the CCMWA is currently under enforcement by the TCEQ. Under the terms of the Enforcement Order (Docket No. 2001-0896-MWD-E; Enforcement Case No 7995), CCMWA must be in compliance by June 2007.

References

City of Austin 2005. *Preliminary Report on Storm Water Runoff from Effluent-Irrigated Golf Courses*. <www.ci.austin.tx.us/watershed/downloads/prelim_golf_course.pdf>.

Environment Texas Research and Policy Center 2006. *Troubled Waters: An Analysis of Clean Water Act Compliance*. July 2003-December 2004. Austin, TX.

TWC 1987. *Waste Load Evaluation for Cibolo Creek Below the Edwards Aquifer Recharge Zone in the San Antonio River Basin: Segment 1902-Lower Cibolo Creek, Segment 1913-Mid Cibolo Creek*. WLE 87-01.

TCEQ 2004. *2004 Texas Water Quality Inventory and 303(d) List*. <www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html>

TCEQ 2003. *Public Participation in TMDL Projects: A Guide for Lead Organizations*. <www.tceq.state.tx.us/assets/public/implementation/water/tmdl/publicparticipation.pdf>.

TCEQ 2003. *Procedures to Implement the Texas Surface Water Quality Standards*. RG-194.

TCEQ 2002. *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data 2002*. <www.tceq.state.tx.us/assets/public/compliance/monops/water/02twqmar/02_305guide_final.pdf>.

TCEQ 2000. *Texas Surface Water Quality Standards*. Texas Administrative Code, Title 30, Chapter 307. <www.tceq.state.tx.us/permitting/water_quality/wq_assessment/standards/WQ_standards_2000.html>.

TCEQ 1999. *State of Texas 1999 Clean Water Act Section 303(d) List and Schedule for Total Maximum Daily Loads*. SFR-58/99.